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THESIS

PC to Mainframe Connection:
IBM PC 3270 Emulation

by

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March 1989

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IBM PC 3270 Emulation

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Submitted in partial fulfillment of the requirements for the degree of

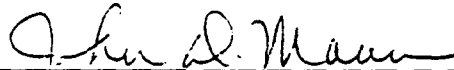
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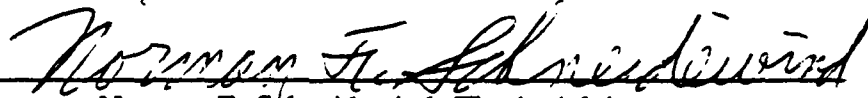
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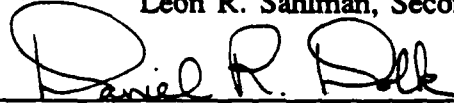
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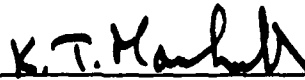
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ABSTRACT

The purpose of this thesis is to provide nontechnical information concerning microcomputer to mainframe connectivity utilizing terminal emulation. The focus is on IBM, and IBM compatible, microcomputers and on IBM PC 3270 Terminal Emulation. An appendix to this thesis is a User's Manual for the IBM PC 3270 Emulation Program, version 3.00. This manual is intended for use in the Administrative Sciences Department microcomputer labs of the Naval Postgraduate School.

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I. INTRODUCTION

A. BACKGROUND

Over the years, government and large business organizations have invested heavily in the mainframe computer system as the repository for the corporate data base. With the proliferation and growing sophistication of microcomputers, however, an increasing amount of the computing burden is being shifted from the mainframe to the microcomputer. [Ref. 1:p. 3]

Microcomputers and mainframes represent the two ends of the computing spectrum. Each system has its own strengths and weaknesses with neither system being a replacement for the other. The microcomputer brings to an organization an economical and practical approach to many of the day to day computing tasks that arise. Some of these tasks may not be suitable for the mainframe and for some of those that are, use of microcomputers may represent the more practical approach. Applications such as word processing, database management, spreadsheets, and graphics are easily accomplished in an office environment on a microcomputer.

For its part, the mainframe computer is a tremendous resource that offers capabilities and opportunities that microcomputers cannot begin to approach. Some of the benefits of the mainframe include the ability to access the corporate database, to provide access to expensive peripheral equipment not normally available in the office environment, electronic mail, access to global networks, the ability to easily share data,

and the ability to use larger more sophisticated programs than possible on microcomputers.

Together, the microcomputer and the mainframe offer computing power far greater than the sum of the individual parts. Their combination can bring the power of the mainframe into the office environment to complement and greatly expand the computing potential. Integrating the capabilities of these two types of computers requires a method to link two vastly different systems and technologies together.

The connection methods can take various forms using a combination of hardware and software located on the microcomputer, the mainframe computer, or on both. The actual physical connection between the microcomputer and the mainframe can be made through some type of cable such as coaxial cable connected to the host mainframe or through a modem using either leased or dial-up communication lines. In either case, the microcomputer can be an independent computer or a part of a local area network (LAN).

The microcomputer can be connected directly to the mainframe when configured with a standalone option or it can be indirectly connected through a gateway computer on a local area network. When using the standalone option the microcomputer can be independent of other microcomputers, or it can be a part of a LAN, with the necessary software provided by the server.

The physical connection between the microcomputer and the host mainframe is only part of the connectivity problem. Once the link exists there must be a common language established for the two systems to communicate. Ideally, the mainframe should be capable of communicating with many different and incompatible types of

computers. It would be virtually impossible to configure the mainframe to recognize all potential types of microcomputers that might be connected. An alternate approach is to maintain a standard mainframe interface and require that any microcomputer that is connected be individually configured to that mainframe interface.

One form of communication with a mainframe is accomplished via a terminal. The terminal provides for input and output functions but usually offers no added computing capacity. If a microcomputer is used as the interface to the mainframe it must emulate the functioning of the terminal the mainframe expects to see. This emulation is accomplished through a combination of hardware and software located on the microcomputer and on the mainframe. When properly set up and functioning, terminal emulation allows the microcomputer to perform all of the functions normally performed on a dedicated terminal. At the same time, the microcomputer retains all its own computing capabilities.

Terminal emulation is important for a variety of reasons. Perhaps the most important is that it brings the capabilities of the mainframe into the office environment and makes available to many, information that was previously at the disposal of only a few data processing professionals.

B. OBJECTIVES

The objectives of this thesis are fourfold, and include both general and specific information.

The first objective is to provide a consolidated reference of general information on terminal emulation. This information will be aimed at those personnel who may

be required to use emulation as a necessary part of their daily work but who do not have any formal experience or training with computers.

The second objective is to address the functional characteristics that are desired of terminal emulation and those characteristics that are normally found. Capabilities and limitations of terminal emulation are also discussed.

The third objective is to examine the hardware and software issues that are important to selecting and installing terminal emulation equipment.

The fourth objective is to develop a user's manual for IBM PC 3270 Emulation for use in the microcomputer labs of the Administrative Sciences Department at the Naval Postgraduate School.

C. SCOPE

There are many different ways in which to implement terminal emulation and it can be accomplished on virtually any computer. At the Naval Postgraduate School, however, an IBM 3033 mainframe computer is available for use by all students and faculty. Additionally, two microcomputer labs are set up to allow IBM PC 3270 Emulation. Consequently, this thesis focuses on the capabilities and limitations of IBM 3270 Emulation. The major issues involved in terminal emulation are discussed. The IBM PC 3270 Emulation Program, version 3.00 is evaluated and a User's Manual is included as an appendix to the thesis for use in the Naval Postgraduate School microcomputer labs.

D. LITERATURE REVIEW

Gaining access to literature on terminal emulation has proved difficult. Most of the information obtained was found in trade journals such as the *Connectivity* supplement to *PC Week*. IBM manuals for the 3270 Emulation program were also used extensively for both general and specific information.

There appears to be an adequate amount of information available but no easy method for locating that information. The difficulties encountered during the literature review reenforced the objectives of the thesis to provide a consolidated reference on emulation.

E. ORGANIZATION OF STUDY

The thesis is divided into four major sections. Chapter II covers the general information on terminal emulation, including it's purpose, the different types of emulation, and implementation issues.

Chapter III covers the functional requirements of terminal emulation. It addresses the area of what terminal emulation can and cannot do for the user.

Chapter IV is devoted to the capabilities and limitations of IBM PC 3270 Emulation.

The appendix contains a User's Manual for the IBM PC 3270 Emulation Program, version 3.00. This manual is intended for use in the two microcomputer labs belonging to the Administrative Sciences Department at the Naval Postgraduate School.

II. TERMINAL EMULATION

A. INTRODUCTION

All computers, from microcomputer to mainframe, must be capable of communicating externally in order to input and output instructions and data. With large mainframe computers there are a wide variety of available interfaces. One of the most recognized and universal type of interface is the terminal. The terminal usually consists of a keyboard for the input of data and some type of output display device such as a video screen or a printer. In many cases the terminal is a 'dumb' device. The terminal is dumb in the sense that it is not capable of functioning independently of the mainframe. It cannot process data by itself. Usually, the terminal does not incorporate any type of data storage device such as a floppy disk drive or a tape drive.

Each mainframe computer expects to have a certain type of terminal attached and will not function properly with other types. Characteristics of the terminal, such as the communications protocol, the number and types of keys available, and the character set generated, are important features that must be supported by the mainframe. Utilizing terminal emulation, a microcomputer can be made to appear to the mainframe as a proper terminal. When set up, the mainframe will not be able to distinguish between a terminal and the microcomputer emulating a terminal. In addition to performing all the functions normally handled by the terminal, the microcomputer retains its own computational ability. There are a variety of reasons to use a microcomputer in place of a terminal. These reasons will be discussed in Chapter III.

With terminal emulation, a network is formed between the microcomputer emulating a terminal and the mainframe. As with all computer networks there are many issues to resolve in order to achieve an effective link. These issues include software and hardware selection, communications protocols, and interconnection schemes. Additional issues involve management concerns such as security of the corporate database, data integrity, unauthorized access, and the amount of an investment required to implement the connection.

This chapter outlines the different types of microcomputer to mainframe interconnection strategies and typical management concerns. The emphasis will be on IBM type systems.

B. PROTOCOL CONVERSION

A protocol is a communication standard that allows two (or more) computers to be interconnected. The protocol must address the entire spectrum of connection issues from the actual physical connection to the format of the data transmitted between the computers. [Ref. 2:p. 70]

Synchronous and asynchronous communications are the two most commonly used protocol categories for communicating with the mainframe computer [Ref. 1:p. 26]. In addition to the communication protocol, another issue that must be addressed is the type of character set used. ASCII is used primarily on the microcomputer and EBCDIC primarily on the IBM mainframe.

Most microcomputers are asynchronous devices. Asynchronous communication requires no synchronization between the transmitting computer and the receiving computer. This type of communication is useful when there is no set time interval

between the transmission of characters. Data is sent in eight bit bytes with one bit added to the beginning of each character that is known as a start bit and one (or two) bits added to the end that are known as stop bits. These start and stop bits define the character for the receiving device and allow for random transmission. Asynchronous transmission has the advantage of being inexpensive and easy to implement, but is less efficient. For each eight bit character a minimum of ten bits must be transmitted. Additionally there is very little error checking, other than parity errors, associated with asynchronous transmission. [Ref. 1:p. 27]

IBM mainframe computers are synchronous systems. In a synchronous system the information to be transmitted is collected in frames or packets of some predetermined length such as 512 or 1024 bytes. Synchronization must be established for the frame or packet as a whole, not the individual characters. Additional characters will be added to the data to signal the beginning and ending of the blocks. This efficiency is generally far greater than for asynchronous systems. While synchronous systems are more complicated than asynchronous systems, they are much more efficient. Synchronous systems allow for more error checking and consequently the communication is more reliable. [Ref. 1:p. 27]

The character set used on most microcomputers is called ASCII (American Standard Code for Information Interchange). ASCII is a seven bit code (or seven bits plus one parity bit) that consists of 96 characters and 32 control codes.

The IBM mainframe normally uses a character set called EBCDIC (Extended Binary Coded Decimal Interchange Code). EBCDIC is an eight bit code.

To connect the microcomputer to the mainframe requires a complete protocol conversion from asynchronous to synchronous communication and from an ASCII data format to an EBCDIC format [Ref. 1:p. 145]. This conversion can take place at several locations, either on the microcomputer, on the mainframe computer, or between the two. The conversion between one data format and another (ASCII and EBCDIC) need not occur at the same location as the conversion between an asynchronous and a synchronous type protocol. Regardless of how the microcomputer is connected to the mainframe, however, the microcomputer will require software to provide terminal emulation.

Protocol conversion on the microcomputer can be achieved in several ways. The first option is by installing a 3270 coax board directly in the microcomputer. This board is connected via coax cable directly to a 3274/3174 cluster controller which is connected to the mainframe. The cluster controller permits the connection of numerous terminals and microcomputers to the mainframe. This configuration allows the microcomputer to operate as a terminal, with performance about equal to that of a dedicated terminal. [Ref. 1:pp. 149-150]

A second option is to have an external protocol converter attached to the microcomputer through an asynchronous RS-232 port. This configuration is appropriate for asynchronous terminals or for microcomputers that can not take plug-in coax boards. Performance of this system is typically less than that of a microcomputer with an internal board. [Ref. 1:pp. 150-151]

A third option for protocol conversion at the microcomputer is to have the microcomputer emulate a cluster controller. With this connection method a

synchronous interface board is installed in the microcomputer and the microcomputer is connected via a synchronous modem to the front-end processor (FEP) of the mainframe. The front-end processor is used to connect slow speed terminal devices to a mainframe. [Ref. 1:pp. 138, 151]

To achieve protocol conversion between the microcomputer and the mainframe, a multiline protocol converter is attached to the mainframe. This converter acts like a dedicated cluster controller and can be attached either directly or remotely through an FEP or directly through a channel. The microcomputer must have an asynchronous adapter and terminal emulation software. [Ref. 1:p. 152]

To achieve protocol conversion on the mainframe, several options are available. The conversion can take place in the FEP, as an application running on the mainframe, with a system that has asynchronous communications support, or on the mainframe itself. SIMPC is an example of this last type of protocol conversion. [Ref. 1:pp. 154-155]

Finally, protocol conversion can be accomplished through a local area network with a 3270 server acting as a gateway. The server provides the terminal emulation capability to individual microcomputers connected to the LAN. [Ref. 1:pp. 155-156]

Each of these configurations can be achieved with some form of direct connection (coax or twisted pair) or through the use of leased (or dial-up) telephone lines and a modem. At remote sites, where it is not feasible to run coax cable directly to the mainframe, microcomputers are typically connected to a cluster controller via coaxial cable, and the controller, in turn, is connected through a modem to the mainframe [Ref. 2:p. 96].

In addition to the mainframe connection, the microcomputer connected with the standalone option can also be a part of a local area network. This network can be completely separate from the mainframe environment.

C. NETWORK OPTIONS

Some of the main connection issues concern whether the connection should be direct or dial-up and whether terminal emulation should be achieved with the microcomputer utilizing a standalone option or utilizing a gateway option.

The direct connection has two principle advantages; the cable allows for faster operation and it is generally more immune to line noise problems than with the dial-up option. On the other hand, the dial-up option allows greater flexibility in the location of the microcomputer and allows more microcomputers to be connected. Although the number of simultaneous connections depends on available ports on the mainframe.

Disadvantages for the direct connection include the cost of cables, the necessity to physically route the cable from the site of the microcomputers to the mainframe and the number of ports on the mainframe to which the connection must be made. Disadvantages of the dial-up method include the reduced efficiency (because of transmission speed) of the connection, the susceptibility to line noise, and the need for modems on both ends of the connection.

The standalone option gives the flexibility to work independently, but has the disadvantage of requiring both hardware and software for each microcomputer and the use of a mainframe port for each connection. The hardware costs can be quite high, with emulation boards and coaxial cable required to individually connect each

microcomputer to the host. If the standalone option is used with a LAN, the software need only be installed once on the server; however, each microcomputer that is to be configured for emulation will still require appropriate hardware.

The gateway option allows a group of microcomputers connected in a LAN to have access to the mainframe without the expense of extra hardware (except for the server computer) for each microcomputer. Disadvantages include the dependence on the server and a reduced efficiency when compared to the standalone option. The reduced efficiency will normally not be apparent to the user unless the network is heavily loaded. An additional disadvantage is caused by the requirement for two versions of the emulation software. The Gateway requires the gateway version of the software and each user computer requires an individually installed copy of the user version of the emulation software. Each user computer must be identified to the gateway via a station number. This precludes the use of one version of the emulation software on the server for all the user computers. The number of simultaneous connections is dependent on the number of available mainframe ports.

D. IMPLEMENTATION ISSUES

Selection of a suitable microcomputer to mainframe connection strategy can become a complicated task. The selection requires a thorough analysis of the existing systems and user requirements to ensure that the required functionality is achieved and that the resulting system will be cost effective and appropriate for the organization.

One of the first considerations is the type, amount, and location of currently installed hardware. This may drive the selection process. An IBM mainframe, for example, requires a synchronous terminal or emulator and so dictates 3270 type

emulation. If the mainframe is in a remote location, or if the potential users are located at a distance from the mainframe a dial-up connection strategy may be needed instead of a direct connection.

Throughout the selection process, costs will have to be weighed against requirements. Costs include the buying of cables, modems, adapter boards, software, and other equipment. These costs must be compared for all the alternative strategies for the mainframe connection.

Other important considerations involve management concerns. Terminal Emulation provides a much more flexible operating environment that can significantly enhance mainframe usage. Emulation also provides many more features and capabilities than are available from dedicated terminals. Because of this flexibility, additional consideration must be given to several areas. First, is the security of the corporate database. Each new connection to the mainframe provides the potential for unauthorized access to an organizations database. With microcomputers, the potential harm is magnified when compared to that of a terminal. The ability to download data from the mainframe to a microcomputer floppy disk has serious implications that cannot be overlooked. Two issues that must be addressed are security for the microcomputer from unauthorized use or theft and security for any proprietary data or programs on the mainframe from unauthorized disclosure. If dial up communication is utilized the potential exists for anyone with a computer and modem to invade the mainframe. [Ref. 2:p. 174]

Another important consideration is that of data integrity. Here there are two main problems. As more users gain connectivity and access to the corporate database there

are an increasing number of opportunities for some users to modify the data, either maliciously or by accident. A second concern involves downloading data from the mainframe and performing modifications for local use without changing the corporate database. This produces two different copies of the data with no clear indication as to which copy is correct. [Ref. 3:p. 16]

Another concern is the issue of disruption to the data processing department. Increasing the number of access points to the mainframe increases the likelihood of causing problems for both maintenance and for normal operating response times. During installation there is also the potential to interfere with routine services. [Ref. 3:p. 16]

Finally, management must provide training to all users on the operation of the microcomputer, the mainframe operation and files to which they will have access, and on the terminal emulation software that will be used on the microcomputer.

E. SUMMARY

The proper selection and installation of terminal emulation capability requires a detailed analysis of the organization to include a study of the current hardware, organizational goals and potential future requirements, and consideration of numerous management concerns. Cost will likely be one driving factor but should not be the overriding consideration. A thoughtful, well planned selection and installation process will ensure that the organizational requirements are met and the resulting system is a useful addition.

III. FUNCTIONAL REQUIREMENTS OF TERMINAL EMULATION

A. INTRODUCTION

When considering all potential uses, emulation functionality can be divided into three broad categories. These categories are terminal emulation, integrated applications, and using the mainframe as a peripheral to the microcomputer. Users are not restricted to any one or two of these categories, but will likely employ applications from all three.

B. TERMINAL EMULATION

This category of use involves the most basic functionality. The microcomputer is used strictly as a mainframe terminal, duplicating the use that would be obtained from that of a *dedicated terminal* [Ref. 1:p. 6]. Essentially, the microcomputer operates on a mainframe database or file using mainframe processing capabilities. None of the independent processing capabilities of the microcomputer are required or used. When used in this manner, the microcomputer does not offer any advantages over a terminal.

C. INTEGRATED APPLICATIONS

The majority of terminal emulation functions fall into the category of integrated applications. Included here are those applications that involve the use of the microcomputer as more than just a 'dumb' terminal. In this category, either the microcomputer operates on a mainframe database using microcomputer based processing

capability or the mainframe operates on a microcomputer database using mainframe based processing capabilities.

The principal benefits of terminal emulation, beyond that of simple connectivity, come from the ability to transfer data electronically from the mainframe environment to the microcomputer environment and vice versa. This transfer of data can take several forms, from data capture facilities, where a snapshot of the screen is saved to floppy or hard disk on the microcomputer, to complete transfer of data files or programs between the mainframe and the microcomputer.

Data from any mainframe based database can be downloaded to the microcomputer for inclusion in reports or graphs. In addition, this data can form the input for microcomputer based programs such as Lotus 123 or dBase III. This gives the manager a more flexible working environment in that he can use programs that are more likely to be familiar to himself and other office workers and it also reduces the dependence on, and inherent delays associated with, a data processing department.

Data can also be downloaded to a microcomputer, changed or updated with local programs and then uploaded back into the original mainframe database. Allowing unsupervised updates carries a much greater risk to data integrity and is not likely to be a standard option for organization wide databases. With proper controls, however, this can be a viable procedure for updating data.

The ability to download data from the mainframe and to perform work on that data offline on a microcomputer offers two distinct advantages. First, if the mainframe is heavily utilized, performing work on the microcomputer will cut down on the amount of timesharing required with a corresponding improvement in response times

to those who must work from the mainframe. Additionally, the user will now be able to work with the data on the microcomputer with only small response time delays. The second advantage occurs in those situations where the mainframe is situated in a remote location and accessed via commercial lines. Working offline will result in lower connection times and consequently lower connection fees. [Ref. 4:p. 19]

Many mainframes are connected to other networks such as the Defense Data Network (DDN), which gives world wide connectivity, or BITNET which is used at colleges and universities around the country. Connectivity with the mainframe gives the microcomputer user potential access to these resources.

Frequently a microcomputer user requires access to the mainframe to use mainframe programs on local data. These programs may be too costly to purchase for the microcomputer, may be used so infrequently that their purchase would not be cost effective, or may require greater computing power than available on the microcomputer.

D. THE MAINFRAME AS A PERIPHERAL

The third broad category of use is that of using the mainframe as a peripheral to the microcomputer [Ref. 1:p. 96]. Here the mainframe assumes a more passive role, providing services to the microcomputer.

There are many types of programs and peripheral equipment that are far too costly to purchase in large quantity. Sophisticated graphics programs or high speed laser printers, for instance, are typically used in connection with the mainframe. Terminal emulation gives the user access to these and others, not only for mainframe based applications but local microcomputer based applications as well.

The mainframe has a tremendous amount of storage capacity for files and programs when compared to even the most advanced microcomputer. For some users this may be the most attractive feature of mainframe connectivity. Using the mainframe to store data has the added benefit of providing a data backup capability. One of the most difficult tasks to accomplish in an office environment with microcomputers is to establish, and consistently maintain, a data backup policy. On the other hand, most well run computer centers consistently perform this function on a weekly or even a daily basis. As microcomputers become more entrenched in the workplace better attention will be paid to good computing practices, but for now this is a distinct advantage of the mainframe.

Microcomputers are extremely susceptible to access by unauthorized personnel. Whether this access occurs in a benign or malicious manner, there is a need to provide security for organizational data. Maintaining data on the mainframe is one way to provide for a portion of this security. All the security measures normally available to the computer center will be available to microcomputer data stored on the mainframe. [Ref. 1:pp. 97-98]

The mainframe can also be used as a medium to transfer information from one microcomputer to another. Data or messages can be placed on the mainframe at one location and downloaded from another. Similarly the mainframe offers the capability of disseminating information (such as messages or reports) to a wide variety of people, locations, and computers using electronic mail facilities.

E. USER REQUIREMENTS

Any new system, no matter how sophisticated, and regardless of the potential benefits, must be accepted by the user in order to be considered successful.

Most users of terminal emulation will probably not be data processing professionals. Some may initially be familiar with either the terminal or the microcomputer, but probably not both. A primary consideration for these people is the ease of learning about, and using, terminal emulation. The user focus has got to be that of using emulation as a tool for the more effective and efficient accomplishment of some aspect of the organizational mission. If that tool is overly complex it is not likely to be used and, thus, is of no value!

The system must also be easy to use on a continuing basis. Complicated microcomputer boot up, or mainframe access procedures will quickly become a burden. Likewise, software with detailed menuing systems are initially easy to use but as experience is gained, these menus become an impediment to rapid data processing. Batch files can be used to reduce the boot up and applications access problems.

The terminal emulation functions beyond those of a normal terminal should be readily available to, and understandable by, the user. This implies well documented procedures along with proper training for the new user. Documentation may well be the most critical aspect of any new system implementation.

As much as possible, the fact that terminal emulation is being used should be transparent to the user. Keyboard incompatibilities between terminals and terminal emulators can be very frustrating. Simple tasks on a terminal may take a complicated sequence of keystrokes to accomplish on a microcomputer. Much of this is

unavoidable, although the impact can be lessened by well written documentation. Some terminal emulation programs allow the system manager to remap the keyboard definitions as desired. This allows the manager to establish a standard layout that is compatible with other familiar programs or to simply make the functions easier to perform or to remember. A second problem is that of response time. If the terminal emulator is connected through dial up lines or through a network that is heavily loaded, the response time is likely to be noticeably slower than that of a terminal connected directly. This area requires a thorough analysis prior to installation of the system to balance alternative systems against potential use.

Finally, there must be a knowledgeable point of contact for the terminal emulation system. This contact must be easily accessible to every user of the system to answer questions, provide instruction, and maintain the system. Ideally, this individual should be from within the organization for ease of access and expense considerations.

F. SUMMARY

Terminal emulation offers a wide range of capabilities to an organization. It can improve computing in both the mainframe and the microcomputer environments.

The capabilities presented here are some of the more obvious applications, but this is by no means an all inclusive list. The number of applications for terminal emulation is very large and will grow with continued use.

As with all systems, the installation of terminal emulation must be well planned and continuing support must be provided for the users in the form of knowledgeable personnel and well written documentation.

IV. IBM PC 3270 EMULATION

A. INTRODUCTION

Connectivity between a microcomputer and mainframe computer is achieved utilizing a combination of hardware and software. IBM PC 3270 Emulation allows IBM and IBM compatible microcomputers to connect with host IBM mainframes. The 3270 Emulation package contains the software required to make this connection. The required hardware will depend on the system configuration and connection strategy that is desired.

The focus of this chapter will be on hardware and software requirements, system configuration options, and available emulation functions for IBM PC 3270 Emulation.

The information for this chapter came from the *IBM PC 3270 Emulation Program Version 3.00 System Planner's and User's Reference* and the *IBM PC 3270 Emulation Program Version 3.00 User's Guide*.

B. HARDWARE AND SOFTWARE REQUIREMENTS

IBM PC 3270 Emulation was designed to work on the IBM PC, PC XT, PC AT, and the Portable PC computers. Although not specifically mentioned in the IBM documentation, 3270 Emulation will work on true IBM compatible computers. Complete compatibility is probably impossible to obtain and some functionality may be lost or problems may arise if using a non-IBM computer.

The 3270 Emulation program can be set up to work on computers equipped with 5.25 inch double sided diskettes, 3.5 inch diskettes, or from a hard disk. Single density disks will not hold the entire emulation program and are not supported.

A considerable amount of random access memory (RAM) is required depending on the configuration of the emulation system. PC DOS will use between 45 kilobytes for version 3.1 and 60 kilobytes for version 3.2. In addition, the COMMAND.COM program will take between 21 kilobytes (DOS 3.1) and 23 kilobytes (DOS 3.2). The emulation program itself requires between 156 kilobytes and 283 kilobytes depending on the type of workstation that is being installed. For example, the Standalone option with distributed function terminal (DFT) attachment takes 166 kilobytes and the Gateway option on a Token Ring network with DFT attachment requires 253 kilobytes. DFT stands for distributed function terminal. A DFT attachment allows five concurrent emulation sessions to be initiated. If other 3270 Emulation options are desired, additional RAM will be required. For instance, file transfer takes 18 kilobytes and print support takes 11 kilobytes. There are additional options that require varying amounts of memory. All of these memory requirements are cumulative and can add up to over 450 kilobytes. This is a significant portion of available memory in a microcomputer and consequently, careful planning is required during installation. [Ref. 5:pp. A14-A17]

The version of the operating system required depends on the configuration that will be installed. At a minimum, IBM PC DOS (or MS DOS) 3.1, or higher, is required. If the computer is to be used in a Token-Ring network, IBM PC DOS 3.2, or higher, is required.

C. SYSTEM CONFIGURATION OPTIONS

A microcomputer using 3270 Emulation can be attached to a host mainframe using one of three different methods, synchronous data link control (SDLC), distributed function terminal (DFT), or Token-Ring.

With an SDLC adapter card, the microcomputer is connected to the host communications controller through the use of modems and telephone lines. [Ref. 5:p. 3-39]

With the DFT option using a 3278/3279 Emulation adapter card the microcomputer is connected via coaxial cable to a control unit (3174 or 3274). The control unit may be connected either directly to the host or connected through a modem to the communications controller on the host. This option allows five concurrent emulation sessions. [Ref. 5:p. 3-38]

With the Token-Ring option a 3278/3279 Emulation adapter card is used to connect the microcomputer to the host communications controller. This controller must have a Token-Ring capability. [Ref. 5:p. 3-41]

The DFT option and Token-Ring option refer to capabilities of the control unit (3174 or 3274) and not the setup of the network where the microcomputers are located.

A microcomputer can be set up to operate as one of four types of 3270 Emulation workstations with one of two connection options, either a standalone or a gateway configuration.

The first type of workstation is the Standalone. As a standalone, the microcomputer is connected directly to the host. The microcomputer may be independent or may be connected to a LAN. If part of a LAN, the other

microcomputers on the LAN will not have connectivity with the host through the standalone. [Ref. 5:p. 2-18]

The second workstation is a Gateway. With this workstation, the gateway microcomputer connected to the host may also operate as the server to a LAN. Network stations on the LAN gain access to the host through this Gateway computer, however, the gateway is not used as a workstation. [Ref. 5:p. 2-19]

When using a gateway option and a DFT host attachment method, five network computers can communicate with the host simultaneously. The gateway option with either SDLC or Token-Ring attachment to the host will support up to 32 concurrent sessions.

The third workstation is a Network Station Workstation. This simply refers to the microcomputer on a LAN that gains connectivity with the host through the gateway. [Ref. 5:p. 2-20]

The final workstation is that of the Gateway with Network Station Workstation. This refers to the gateway computer performing emulation tasks with the host. [Ref. 5:p. 2-21]

D. FUNCTIONS

IBM PC 3270 Emulation allows the user to perform all of the tasks normally associated with dedicated 3278/3279 terminals. In addition, 3270 Emulation provides the user with capabilities that are not possible from a terminal. The primary emulation features are summarized below.

The Alternate Task feature of 3270 Emulation allows a user to begin a 3270 session, and without terminating that session, load and run another application program

in an area called the Alternate Field. The user can then switch back and forth between the application program and the emulation session. The workstation must be properly configured for Alternate Tasks. Some IBM compatible computers will not function properly in this mode.

File transfer can be accomplished from the workstation to the host and from the host to the workstation. Such file transfers can be accomplished from either the 3270 session or from the Alternate Field. Optional parameters that can be added to file transfer commands allow for the conversion between ASCII characters on the workstation and EBCDIC on the host. An append command allows the user to add the current file to the end of a file that already exists.

With 3270 Emulation, documents and screens can be printed on a local printer attached to the workstation or on a printer attached to a LAN. Printing is accomplished in one of two modes, either direct or deferred. As the mode names indicate, direct printing causes the screen or document to be printed immediately, while deferred print saves the current screen or document to the workstation disk, to be printed at a later time.

Keyboard remapping allows the user to customize the definition of the keys. Remapping may be done to customize the keyboard to an office standard or simply to make the key definitions easier to learn or use. Two forms of keyboard remapping are supported by 3270 Emulation.

Global keyboard remapping allows the user to change the keyboard definitions for all programs that are subsequently run and that do not themselves remap the keyboard. 3270 remapping changes the keyboard definitions within the 3270 Emulation

session environment. Normal keyboard definitions apply when other program are loaded and run and when utilizing the Alternate Field from within an emulation session.

The 3270 Emulation program also allows the user to change the screen mode and the colors. The screen mode may be changed between color and black and white. This change is made from within a terminal emulation session. Individual colors can only be changed prior to loading 3270 Emulation.

IBM 3270 Emulation offers two advanced features, Server-Requester Programming Interface (SRPI) and Presentation Space Application Programming Interface (PS API). These features allow the user to pass data and keystrokes between a program running in the Alternate Field and applications located on the host (for SRPI) or to a 3270 Emulation display session (for PS API). [Ref. 5:p. 3-6]

E. SUMMARY

IBM PC 3270 Emulation is one option to achieve mainframe connectivity. It offers many attractive features to fully utilize the power of a microcomputer as more than just a mainframe terminal. A variety of computers and configuration options are supported. Drawbacks include the requirements for a large amount of RAM to make full use of the emulation features, keyboard inconsistencies between terminals and microcomputers, and compatibility problems with non-IBM microcomputers.

V. CONCLUSION

Establishing connectivity with the mainframe can be a complicated undertaking. It involves the consideration of hardware, software, managerial issues, and ultimately, the potential user of the connection. As information needs grow, and mainframe access becomes even more important, the needs of the system user must become the focus of attention.

The first step to meeting the needs of the user must be to provide clear, nontechnical, and useable information about the system under consideration. Second, each new system requires the development of documentation that clearly presents the requisite information needed to run the system. This information must be presented on the level of the average potential user.

Information on terminal emulation was found in books, magazine articles, and emulation systems manuals. Few of these sources provided complete information and all were replete with computer and network jargon. Most assumed a prior knowledge of key aspects of emulation and would probably make very little sense to a new user. According to Susan Grimm in *How to Write Computer Documentation for Users*, documentation is a critical area for computer systems development.

User documentation must overcome users' apprehension, build confidence, and provide easy-to-follow instructions. The goal is to enable users to prepare and enter their data and use the computer output. The most important ingredient in the process of developing user documentation is the user. After all, if the users of a system are afraid of it or don't understand it, the system cannot achieve its intended purpose. [Ref. 6:pp. 1-2]

APPENDIX

IBM PC 3270 EMULATION USER MANUAL

This appendix is a User Manual for the IBM PC 3270 Emulation program that is installed in Ingersoll Hall, rooms I-224 and I-250 of the Naval Postgraduate School. The User Manual is tailored to the specific configurations of these microcomputer labs and is intended to be used separately from this thesis.

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IBM PC 3270 EMULATION USER MANUAL

A. INTRODUCTION

The Administrative Sciences Department of the Naval Postgraduate School has two microcomputer labs that have IBM PC 3270 Emulation capability. These labs are located in Ingersoll Hall, rooms I-224 and I-250. Access to the labs are restricted to students and faculty of the Naval Postgraduate School. A portion of the microcomputers in each lab have been configured with IBM PC 3270 Emulation, version 3.00. I-250 has four IBM XT microcomputers configured for the standalone option with a DFT attachment to the host. I-224 has ten microcomputers (seven AT Clones and three IBM XT's) configured for the Gateway Option with a DFT attachment to the host.

Section B of this appendix describes the setup of both microcomputer labs, section C provides a program overview, and section D provides detailed instructions to use the terminal emulation program. Section E is a list of 3270 Emulation key definitions.

This manual is intended for use only at the Naval Postgraduate School and is tailored to the specific configurations of the labs in Ingersoll Hall. All the information and procedures were adapted from two reference manuals, *IBM PC 3270 Emulation Program Version 3.00 User's Guide* and *IBM PC 3270 Emulation Program Version 3.00 System Planner's and User's Reference*.

B. MICROCOMPUTER LAB SETUP

1. I-224

I-224 has 15 computers connected in an IBM Token-Ring Network. This network has 12 Standard-286 AT clones and three IBM XT computers. An IBM AT is used as the server. Ten of these computers (seven clones and three XT computers) have been configured for terminal emulation. These ten computers are marked in pairs as MAINFRAME # 1 through MAINFRAME # 5. The instructor station (an XT) is paired with a clone, the two remaining XT's are paired and the six remaining clones are paired. This system uses the gateway option with a DFT attachment to the host. The server has a DFT adapter board installed and is connected to the host through coaxial cable. The gateway version of the emulation software is loaded on the server. The ten user computers are connected to the Token-Ring Network but do not require additional boards to utilize 3270 Emulation and are not directly connected to the host. A user version of the emulation software is installed on the hard drive of each of the user computers. The ten computers are divided into five groups of two computers. With the DFT attachment, only five concurrent 3270 sessions can be initiated, one from each group of two computers. Two users from the same group will not be allowed to utilize 3270 Emulation simultaneously.

Emulation software for the user is maintained on the user computer drive C:, in the directory C:\MAINFRAM. In order to start emulation the user must first join the network and run the batch file D:\MAINFRAM.BAT. This batch file is stored on the server and is responsible for ensuring that only the proper computers are allowed to use the emulation.

All communication with the host is controlled by the gateway (server computer) although the gateway itself cannot be used as a user computer.

2. I-250

I-250 has 25 IBM XT computers connected in an IBM PC LAN. The network has four server computers. Terminal emulation capability has been installed in four computers: CARL, DALE, MARK, AND TAREK. These computers operate off of the server named CARYL. Each is configured for the standalone option with a DFT attachment to the host. Each XT has a DFT adapter board installed and is individually connected to the host through coaxial cable. In order to have access to the emulation programs the user must first start the network. The emulation software is stored on the server and is accessible to the user on the network from the L: drive and directory L:\COMMMAINFRAM. The emulation program is started with the file E:\MAINFRAM.BAT. Although the emulation programs are stored on the server computer the emulation is otherwise completely independent of the operation of the network.

C. PROGRAM OVERVIEW

The 3270 Emulation program menu structure is shown in Figure 1. This hierarchy is logically divided into two sections. The left half of the hierarchy shows the menus that are necessary to set and change the default configuration of the program. The right half shows the menus available during an emulation session. [Ref. 5:pp. 4-4, 4-5]

During normal operation, the user will automatically be placed in the 3270 Frame when the emulation program is started. The 3270 Task Selection Menu is bypassed

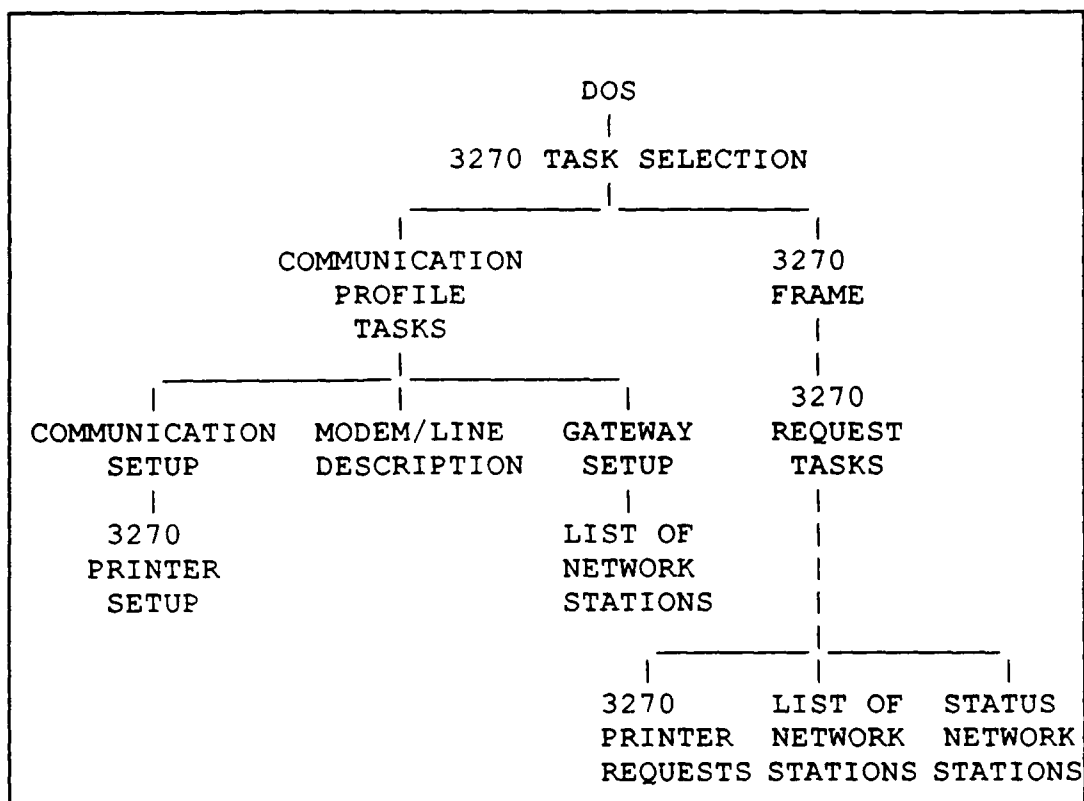


Figure 1 3270 Emulation Menu Tree. [Ref. 5:p. 4-4]

by parameters placed in the MAINFRAM.BAT batch file. This is done for convenience to the user, however, the user still has access to the Communications Profile Tasks Menu.

The batch file, MAINFRAM.BAT, is used to start the emulation program. This batch file checks to ensure the program is being started from one of the computers configured for terminal emulation. In I-224 this file also checks to ensure that only one computer of each mainframe pair uses emulation at the same time. This guarantees that a maximum of five of the ten computers capable of terminal emulation are in use at the same time.

Within the batch file, the command that starts the emulation program has two parameters. The first parameter specifies the directory where the 3270 Emulation programs are maintained. The second parameter is called the 'fast path option'. When used, this parameter causes the 3270 Task Selection Menu to be bypassed and places the user directly in the 3270 Frame.

The remainder of this manual will deal with those menus and functions that are available to the user of 3270 Emulation as configured in rooms I-224 and I-250 of Ingersoll Hall. There are additional features that will not be discussed and should only be performed by the system developer/LAN manager.

D. DETAILED INSTRUCTIONS

1. Keyboard Layout

The keyboards of 3278/3279 terminals and IBM microcomputers are completely different. In order to properly operate as a terminal the microcomputer keyboard must be remapped to provide the functionality of the 3278/3279 keyboard. The 3270 Emulation program automatically remaps the PC keyboard to the default values shown in Figure 2.

The emulation package provides the ability to define the keys as desired, however, this should only be accomplished by the system manager. For a detailed explanation of the functioning of the different keys, look at the Glossary in Section E at the end of this manual.

KEYBOARD TABLE

3278 FUNCTION	PC,XT,AT KEY	3278 FUNCTION	PC,XT,AT KEY
ALT TASKS	ALT-ESC	PF1	F4-1
ATTN	CTRL-F7	PF2	F4-2
CLEAR	F7	PF3	F4-3
CURSER SEL	F6	PF4	F4-4
DEV CNCL	CTRL-F9	PF5	F4-5
DIR	F3	PF6	F4-6
DUP	CTRL-F3	PF7	F4-7
END TASK	F2	PF8	F4-8
ENTER	END	PF9	F4-9
ERASE EOF	F8	PF10	F4-0
ERINP	CTRL-F8	PF11	F4-`-'
FIELD MARK	CTRL-F4	PF12	F4-`=
MSG	CTRL-F10	PF13	F4-Q
PA1	CTRL-F1	PF14	F4-W
PA2	CTRL-F2	PF15	F4-E
PF SELECT	F4	PF16	F4-R
PRINT	CTRL-F5	PF17	F4-T
REQST	F10	PF18	F4-Y
RESET	F9	PF19	F4-U
RETURN	RETURN	PF20	F4-I
SAVE	F5	PF21	F4-O
SYS REQ	CTRL-F6	PF22	F4-P
		PF23	F4-[
		PF24	F4-]

For functions that require multiple keys, press and hold the keys in the order shown. For example, to select the PRINT function, press and hold CTRL and then press F5.

Figure 2 3270 Emulation Keyboard Table

2. Starting the Network

In order to use 3270 Emulation in both I-224 and I-250 the user must first start the Network.

a. IBM Token-Ring (I-224)

To start the Token-Ring network perform the following procedures:

- Select one of the ten computers marked as a mainframe computer.
- Turn the computer on and wait for the C> prompt to appear.
- At the C> prompt type: START NAME and press [ENTER]. NAME can be any alphabetic string of 15 characters or less with no spaces.

From here the computer will be added to the Token-Ring network and the applications directory of the server will be displayed.

b. IBM PC LAN (I-250)

To start the IBM PC LAN network, perform the following procedures:

- Select one of the four computers marked for terminal emulation (CARL, DALE, MARK, OR TAREK).
- Each computer has a boot disk on the desk top. Insert the boot disk into drive A: and turn on the computer.
- After a few moments the monitor will display information about the Microcomputer Lab. Press [ESC] to continue.

- When the A> prompt appears type: START NAME and press [ENTER]. NAME can be any alphabetic string of 15 characters or less with no spaces.
- The network will start and after a few moments the monitor will display "NEWS" about the network. Press [ESC] to continue.

From here the applications directory of the server will be displayed.

Once the network has been started, operation of the 3270 Emulation program is the same in both I-224 and I-250.

3. Running a 3270 Emulation Session

a. Starting an Emulation Session

- To start 3270 Emulation, locate and run the file MAINFRAM.BAT in the applications directory.
- First, a message will appear explaining what to do if you are not on a designated mainframe computer. Strike a key when ready.
- Next, the IBM logo will appear as the 3270 Emulation program loads. When this is complete, the logon screen for the NPS mainframe will appear. At this point, the keys shown in Figure 2 will be active.
- Type your user ID number, press the [TAB] key and type your password, and then press the [END] key.

A mainframe session has now been started and all normal mainframe tasks can be accomplished.

b. Stopping an Emulation Session

- To stop a 3270 Emulation session, first perform the normal logoff from the mainframe.
- After logging off of the mainframe press F2, the END TASK key. A message will be displayed at the bottom of the screen similar to the following: '101 RESET or END TASK - display session active'. This is a chance to return to the 3270 Frame if a mistake was made, or to continue logging out of the session. Press the RESET key, F9, to return to the 3270 Frame.
- To continue to log out of the session, press F2 again. The 3270 Task Selection Menu will be displayed.
- The third option of the 3270 Task Selection Menu is to exit. To exit press z and then [ENTER].

If you are working on one of the AT Clones in I-224 the program will stop and the network screen will be displayed. If using one of the IBM XT computers in either I-224 or I-250 another message will be displayed at the bottom of the screen: 'Before pressing ENTER to exit, press Alt+Esc and stop programs, or press ESC:'. This prompt is a reminder to terminate programs running in the Alternate Field, before exiting 3270 Emulation. The Alternate Field will be discussed later.

- Press [ENTER] to continue with the logoff.

***** CAUTION *****

Stopping the emulation program is independent of the operation of the mainframe. An emulation session can be inadvertently terminated without logging off of the mainframe.

4. 3270 Request Tasks Menu

In the 3270 Frame, the PC behaves just like a 3278/79 mainframe terminal. To utilize the microcomputer capabilities for file transfer, screen save, or print to disk functions, the 3270 Request Tasks Menu must first be accessed. The 3270 Request Tasks Menu is shown in Figure 3, below.

- Press F10 to display the 3270 Request Tasks Menu.
- There are eight selections, lettered a through h. Those selections that are available to the user are marked with an asterisk (*). To make a selection, type the letter corresponding to that selection and press [ENTER].
- To exit this menu and return to the 3270 Frame just press [ENTER].

While using this menu, and any other menu of the Emulation program, the [ENTER] key and the [END] key perform the same function.

The general purpose of each selection is described below. Complete procedures for available options will be given in later sections.

a. Name PC File for 3270 Screen Save

This option allows for the naming of a disk file to use when saving copies of the screen.

3270 REQUEST TASKS

ID	ITEM	YOUR CHOICE	POSSIBLE CHOICES
* a	Name PC File for 3270 Screen Save		
* b	Name PC File for 3270 Print to Disk		
* c	3270 Printer Requests		
* d	File Transfer		
e	Display Status of Network Stations		
f	Revise List of Network Stations		
* g	Data Trace	2	1 = Start 2 = Stp
* h	Screen Mode	1	1 = Color 2 = Black & White

Available options are marked with an asterisk (*).

When finished with this menu, press ENTER.

Figure 3 3270 Request Tasks Menu. [Ref. 5:p. 5-13]

b. Name PC File for 3270 Print to Disk

This option allows for the naming of a disk file for deferred print.

c. 3270 Printer Requests

This selection allows the user to temporarily override the default printer settings.

d. File Transfer

The file transfer option allows for sending files from the PC to the host and for receiving files on the PC from the host.

e. Display Status of Network Stations

This option is not available on the Standalone workstations and the Network workstations.

f. Revise List of Network Stations

This option is not available on the Standalone workstation and the Network workstation.

g. Data Trace

This option is for use by the system manager to aid in diagnosing communication problems.

h. Screen Mode

This option allows the user to change between a black and white and a color screen. The selection takes effect after exiting from the menu.

5. File Transfer

File transfer can be accomplished during an emulation session from the PC to the host or from the host to the PC. File transfer is accessed through the 3270 Request Tasks Menu.

To initiate a file transfer, perform the following steps:

- Press F10 to select the 3270 Request Tasks Menu.
- Select option d, for File Transfer.

- Enter the file transfer command at the prompt at the bottom of the screen. This command is described below.

a. File Transfer Command

The file transfer command is composed of four parts: command, PC filespec, host filename, and optional parameters. The entire command must be entered on one line. Examples of file transfer commands are shown below.

SEND C:\APPS\NOTES.TXT NOTE LISTING A1 (CRLF ASCII

This command will send a file named NOTES.TXT, in the APPS directory of drive C: of the PC, to the host, and name it NOTE LISTING A1.

RECEIVE C:\APPS\NOTES.TXT NOTE LISTING A1 (CRLF ASCII

This command will send a file called NOTE LISTING A1 from the host to drive C: in the APPS directory of the PC, and name it NOTES.TXT.

(1) Command. Command can be either SEND, to transfer a file from the PC to the host, or RECEIVE, to receive a file on the PC from the host.

(2) PC filespec. The file specification of the existing PC file that is to be transferred to the host, or the file specification to be created on the PC by the transfer from the host. This file name can include the disk drive and path to the file.

The path can be up to 32 characters long and the file name can be 12 characters long, including the extension. If an extension is not supplied for a RECEIVE operation, the default, .HST, will be used. The drive designation and the path are optional, the file name is required. The PC filespec occurs first in the command for both SEND and RECEIVE operations. [Ref. 7:p. 7-17]

(3) Host filename. The file specification for the file that exists on the host, or the file that will be created on the host. This specification consists of the filename, filetype, and filemode. The filename is required and can be up to eight characters long. The filetype is required for a SEND operation and is optional for RECEIVE. The filemode is optional. [Ref. 7:p. 7-17]

(4) Optional parameters. There are five optional parameters that can be used in the file transfer command. The parameters are entered following a left parenthesis, '(', and are separated by a space. The parameters are CRLF, ASCII, APPEND, LRECL n, and RECFM F/V. [Ref. 7:p. 7-18]

(a) CRLF. Carriage Return and Line Feed. This parameter causes the host to add a carriage return and line feed to a file that is transmitted to the PC and to remove the carriage return and line feed from files that are sent to the host. If this parameter is omitted the default is no CRLF. [Ref. 7:p. 7-18]

(b) ASCII. This parameter causes the host to convert ASCII characters from the PC to EBCDIC characters for the host during a SEND operation, and to convert EBCDIC characters of the host to ASCII for the PC during a RECEIVE operation. If omitted, no translation will occur. [Ref. 7:p. 7-18]

(c) APPEND. When this parameter is used, the file will be added to an existing file of the same name. If omitted, the existing file (if any) will be overwritten. The default is to overwrite existing files. [Ref. 7:p. 7-18]

(d) LRECL n. This parameter specifies the logical record length of a file sent to the host with the SEND command. The default is 80 characters long. When used with APPEND, this command is ignored and the record length of the current file is used. [Ref. 7:p. 7-19]

(e) RECFM F/V. This parameter is used with SEND and specifies either a fixed or variable record length. The default is F. When used with CRLF the default is V. [Ref. 7:p. 7-19]

b. Cancelling a File Transfer

File transfer can be terminated by pressing the DEV CNCL key [CTRL-F9]. A message will display at the bottom of the screen to indicate that cancellation is in progress and another will display when the cancellation is complete. [Ref. 7:p. 7-29]

You will not be able to exit the emulation session with the END TASK key (F2) until file transfers are complete.

***** NOTE *****

After transferring a file into the host from the PC the host screen may need to be refreshed (PF2) before the change of status will be displayed.

7. Directory Command

Within a 3270 Frame, the user can view the contents of a disk or a specific directory on the PC.

- To view a directory on the PC press [F3] from the 3270 Frame.
- Enter the drive and path for the directory to be viewed.
- Use the [PG DN] key and the [HOME] key to navigate through the directory.
- Press [ENTER] to end the directory display and return to the 3270 Frame.

8. 3270 Screen Save

In order to save a screen from the 3270 Frame to a disk, the user must first establish a file name under which the save will be made. Any legal DOS file name may be used and a complete path may be specified including the drive designation. If an extension is not specified a default of .SAV will be used. An existing file name can also be used. Each time the screen save command is given, a copy of the current screen will be appended to the file specified. A form feed character will separate each screen save. [Ref. 7:p. 8-11]

To save a screen to the disk:

- From the 3270 Frame, display the desired screen.

- Press [F10] to enter the 3270 Request Tasks Menu.
- Select option a, Name PC File for 3270 Screen Save, and enter a disk file name as described above. The 3270 Frame will reappear.
- Press [F5], the SAVE key. The screen will be saved to the disk file.
- If a disk file has been previously named, the second and third steps can be omitted. The screen will be appended to the previously named file.

9. 3270 Screen Print

To send a copy of the currently displayed screen to the printer:

- From the 3270 Frame, display the desired screen.
- Press CTRL-F5, the PRINT key.

There is no capability to send the 3270 Emulation menu screens to the printer. Screen Print using CTRL-F5 will not work in the Alternate Field.

10. Print to Disk

Print to Disk has not been installed on the mainframe and so can not be implemented in the Administrative Sciences Department labs. This option allows for the naming of a disk file for deferred print. As with 3270 Screen Save, any legal DOS file name may be used and a complete path may be specified including the drive designation. If an extension is not specified a default of .DFP will be used. An existing file name can also be used. Each time the deferred print is initiated, the print

will be appended to the file specified. A form feed character will separate each deferred print. [Ref. 7:p. 8-8]

11. 3270 Printer Requests Menu

When this option is selected, the 3270 Printer Requests Menu, shown in Figure 4, is displayed.

3270 PRINTER REQUESTS			
ID	ITEM	YOUR CHOICE	POSSIBLE CHOICES
a	3270 Print Destination	1	1 = Printer 2 = Disk
b	Lines Per Inch	1	1 = 6 LPI 2 = 8 LPI
c	Line Spacing	1	1 = Single 2 = Double
d	Maximum Page Length	66	1 - 99
e	Maximum Print Position	80	1 - 158
f	Compress Line Spacing	2	1 = Yes 2 = No
g	Form Feed		
h	Reprint Buffer		

When finished with this menu, press ENTER.

Type ID letter to choose ITEM; press ENTER:

Figure 4 3270 Printer Requests Menu. [Ref. 5:p. 5-22]

This menu is self-explanatory. The selections made here will temporarily override the default settings. The column labeled 'YOUR CHOICE' shows the current settings and the column labeled 'POSSIBLE CHOICES' list the legal choices for each selection.

Option (g) will send an immediate form feed to the printer.

Option (h) is dependent on the host. If a problem occurs on the local printer such as a paper jam, this option may allow the user to reprint the host's print buffer.

12. Alternate Tasks

The Alternate Task function of 3270 Emulation allows the user to load and run an applications program without terminating the current mainframe session. The user is moved to an area called the Alternate Field. In the Alternate Field the user can load and run most programs whose size is small enough to fit in the available memory. Once a program is loaded and running in the Alternate Field, the user may switch back and forth between this program and the 3270 Emulation session.

The Alternate Task function is only available on the IBM XT computers in I-224 and I-250. Incompatibilities between the AT clones and true IBM computers cause the emulation program to hang up if the Alternate Field is accessed on the AT clones. If this happens the user must reboot. The AT clones have been configured to disallow Alternate Tasks.

- To go to the Alternate Field press ALT+ESC, the ALT TASKS key.
- To return to the 3270 Frame press the ALT TASKS key again.

When in the Alternate Field, the 3270 session is suspended. After returning to the 3270 Frame, a program running in the Alternate Field will be suspended. When using a program in the Alternate Field the function keys will be defined by the applications program in use.

In the Alternate Field, the ALT TASKS key may become disabled under certain conditions. When disabled, a beep will sound if the key is pressed. Higher level graphics programs may cause this to occur. If this happens, termination of the applications program should alleviate the problem. [Ref. 7:p. 6-7]

The user will not be allowed to exit the Alternate Field while a DOS operation is in progress.

***** CAUTION *****

If a program is running in the alternate field and the 3270 Emulation session is terminated, the program in the Alternate Field will terminate and all data will be lost. When exiting from the 3270 session a message will be displayed alerting the user to first terminate any programs in the Alternate Field.

13. 3270 Task Selection Menu

The 3270 Task Selection Menu allows the user to establish a 3270 Emulation session, set the emulation program configuration, or exit the emulation program. Figure 5 shows the 3270 Task Selection Menu.

Normally, this is the first screen presented to the user when initially loading emulation. For the Labs in I-224 and I-250, however, this screen has been bypassed by the fast path option used in the MAINFRAM.BAT batch file.

When exiting the 3270 Frame by pressing the F2 key, the 3270 Task Selection Menu is displayed.

3270 TASK SELECTION	
ID	ITEM
a	Communicate
b	Communication Profile Tasks
z	Exit

Figure 5 3270 Task Selection Menu. [Ref. 5:p. 4-6]

Option a will allow the current user, or a new user, to log back onto the mainframe without restarting the emulation program. If the current user selects this option, he will have to log back into his mainframe account.

Option b will allow a user to set certain program configuration items.

Option z will terminate the emulation program and take the user back to DOS.

14. Communication Profile Tasks Menu

The Communications Profile Tasks Menu allows for the configuration of the emulation program to the needs of the user and the hardware available. Figure 6 shows the menu. Most of the items in this and subsequent menus should normally be

set by the system manager. However, if the emulation program does not seem to be configured properly, the user may check the actual configuration setup.

COMMUNICATION PROFILE TASKS			
ID	ITEM	YOUR CHOICE	POSSIBLE CHOICES
a	Configuration	2	1 = Standalone Stat 2 = Network Station 3 = Gateway 4 = Gateway with Network Station
b	Communication Attachment	2	1 = SDLC 2 = DFT 3 = IBM Token-Ring
c	Alternate Tasks	2	1 = Yes 2 = No
d	3270 Keyboard	101	1 - 999
e	3270 Keyboard Remap	2	1 = Yes 2 = No
f	Create or Revise Communication Setup		
g	Create or Revise Modem and Line Description		
h	Create or Revise Gateway Setup		

Figure 6 Communications Profile Tasks. [Ref. 5:p. 4-8]

Current choices for the menu items are shown under the 'YOUR CHOICE' column and available choices are shown under the 'POSSIBLE CHOICES' column.

On this menu, the only item that should be changed by the user is option c, for Alternate Tasks. Option c should always be set to 2 = No for the AT clones in I-224 because they are not completely compatible with true IBM AT computers. For the IBM XT computers in I-224 and I-250, Alternate Tasks can be set to either 1 or 2, but should normally be set to 1 to allow Alternate Tasks. Options g and h are not available with the Standalone and Network Station computers.

Option f will display the Communication Setup Menu as shown in Figure

7.

Press [ENTER] to return to the Task Selection Menu.

15. Communication Setup Menu

Figure 7 is the Communication Setup Menu. The important entries here are options b and c. Option b controls the ability to use the system printer and should normally be set to 3. Option c allows for file transfer and should be set to 1.

COMMUNICATION SETUP			
ID	ITEM	YOUR CHOICE	POSSIBLE CHOICES
a	3270 Numeric Lock	2	1 = Yes 2 = No
b	3270 Printer Use	3	1 = Screen Print 2 = Host 3 = Screen Print+Host 4 = None
c	File Transfer	1	1 = Yes 2 = No
d	Application Programming	4	1 = Presentation Space 2 = Server-Requester Programming Int 3 = Both 4 = None
e	Station Name	3	Up to 15 Char
When finished with this menu, press ENTER.			

Figure 7 Communication Setup Menu. [Ref. 5:p. 4-16]

To exit this menu. press the ENTER key. If something other than 4 was selected for option b the 3270 Printer Setup Menu will be displayed.

16. 3270 Printer Setup Menu

The 3270 Printer Setup Menu is shown in Figure 8. It allows the system manager to set the default printer configuration for the emulation program. These settings will be in effect on startup but can be temporarily overridden from within an emulation session from the 3270 Printer Requests Menu.

3270 PRINTER SETUP			
ID	ITEM	YOUR CHOICE	POSSIBLE CHOICES
a	3270 Print Destination	1	1 = Printer 2 = Disk
b	Lines Per Inch	1	1 = 6 LPI 2 = 8 LP
c	Line Spacing	1	1 = Single 2 = Dble
d	Maximum Page Length	66	1 - 99
e	Maximum Print Position	80	1 - 158
f	Compress Line Spacing	2	1 = Yes 2 = No
g	Form Feed in Any Position	2	1 = Yes 2 = No
h	Override Formatted Print	2	1 = Yes 2 = No
i	Add Form Feed	3	1 = After Prt Key 2 = After Prt 3 = No
j	Printer Device Name	1	1 = LPT1 (PRN) 2 = LPT2 3 = LPT3

When finished with this menu, press ENTER.

Figure 8 3270 Printer Setup Menu. [Ref. 5:p. 4-25]

When finished with this menu press ENTER and the Communications Profile Tasks Menu will once again be displayed.

At the Communications Profile Tasks Menu press z to return to the 3270 Task Selection Menu. From this point the user can start another session or terminate the program.

If any changes were made to the configuration, the user will need to exit the emulation program completely and restart the program to cause the changes to take effect.

For more detailed directions for the configuration and operation of the 3270 Emulation Program, consult the *IBM PC 3270 Emulation System Planner's and User's Reference* and the *IBM PC 3270 Emulation User's Guide*.

E. GLOSSARY OF 3270 EMULATION KEYS

This section was taken from the *IBM PC 3270 Emulation Program Version 3.00 System Planner's and User's Reference*, pages 5-5 through 5-8. The key definitions listed are valid when in a 3270 Emulation session within the 3270 Frame.

ALT TASKS. Use the ALT TASKS key (Alt + Esc) to switch between 3270 Emulation and the Alternate Field where compatible applications or tasks are run.

ATTN. Use the ATTN key when you are waiting for the host computer to respond and you want to change or end your previous request.

CLEAR. Press the CLEAR key when you want to erase all the characters displayed on your screen.

CURSR SEL. Press the CURSR SEL (Cursor Select) key to allow a host application program to take action on a field.

DEV CNCL *. Use the DEV CNCL (Device Cancel) key to: 1. Cancel a Save request if the Screen Save was unsuccessful. 2. Cancel a Print request if the printer is busy (if the printer is performing a host-initiated screen print, you cannot cancel it with DEV CNCL).

DIR *. Press the DIR key to display the contents of your IBM PC directory. This key is available at all times except when you specify "Yes" for "Alternate Tasks" and "No" for "File Transfer".

Dup. Use the Dup key when required by your host application program.

END TASK. Press the END TASK key to exit the 3270 session.

Enter. Press the Enter key when you want to send a command to the host. When you are in the Request Tasks Menu, you can also use the Return key for the Enter function.

Erase EOF. Press the Erase EOF key to erase all the remaining characters from your cursor position on a line. When you use Erase EOF, the cursor does not move.

ErInp. Use the ErInp (Erase Input) key to erase the currently displayed screen. Most host computer programs allow you to enter information only in certain areas on the screen. When you use the Erase Input key, you erase information only in these fields.

FIELD MARK. Use the FIELD MARK key to mark a field according to an application program at your host computer.

Msg. Use the Msg key to display and remove messages. Messages will either automatically display at the bottom of the screen, or a blinking square or greater than sign (>) in the lower left-hand corner of the screen will indicate that a message is waiting to be viewed.

PA1. Use the PA1 key when required by your host application program.

PA2. Use the PA2 key when required by your host application program.

PF Select. Press and hold down the PF Select key and press the appropriate number key when you want to select one of the PF host-controlled keys on supported IBM PC Keyboards.

Print. Use the Print key to print individual screens from the 3270 Frame. This key will not print host files or screens from the Alternate Field. (Use the IBM PC DOS PrtSc key in the Alternate Field to print screens.)

REQST *. Press the REQST (Request) key when you want to perform a task within the "3270 Request Tasks" Menu.

RESET. Press the RESET key to free the keyboard when you get an Input Inhibited message or when you want to end Insert Mode.

Return. Press the Return key to advance to a new line in a 3270 file or use the Return key as the Enter key in the 3270 Request Tasks or Communication Profile Tasks Menus.

Save *. Press the SAVE key to save the information on the screen in a file on a disk or diskette.

SYS REQ. Use the SYS REQ key to clear your display screen or to switch your workstation between application and control programs. This key is not supported for non-SNA DFT attachments; use of the SYS REQ key may cause you to lose the host session.

Note: The * next to any key denotes that if that key is pressed while in the 3270 Frame, you cannot enter the Alternate Field until the function started by pressing that key is completed.

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